Measurement of the neutron flux in the 1 MW Pb-Bi liquid target of the MEGAPIE project

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The MEGAwattPIlot Experiment at the Paul Scherrer Institute, Switzerland, will be the first experimental demonstration of feasibility for a long term operation of a "realistic" liquid Pb-Bi spallation target irradiated under a 1 MW (590 MeV, 1.7 mA) proton beam. During one year target operation, we plan to measure the components of the neutron flux generated in this innovative spallation target.

To achieve this goal, 8 micro fission chambers will be inserted in the central rod of the target to measure thermal, epi-thermal and fast components of the neutron flux. As thermal component of the flux will be measured with U235 deposit detectors, epithermal neutrons will be detected using 250 micro meter Gadolinium shielded detectors and fast neutrons will be probed with threshold fission detectors (Pu242 and U238). These neutron detectors, that have been designed to stand high intensity neutron fluxes ($> 10^{14}$ n/s/cm^2), will allow to monitor time and space variations of the neutrons flux at the level of 1%, giving thus access to an integral validation of neutron generation and transport models. The impact on the neutronic balance of spallation residuals inside the liquid target will be also evaluated.

New types of fission chambers have been thus recently developed to stand the high (600°C) and frequent (T=200°C every 20 mn) temperature variations together with the strong mechanical end electromagnetic constraints expected all along the irradiation of the MEGAPIE target. We will present their characteristics and the results obtained in term of signal accuracy, background sensibility, and electromagnetic shielding after integral tests performed at the Institute Laue-Langevin of Grenoble (France).

In parallel to neutron flux measurements, two detectors will be dedicated to the study of transmutation of Am241 and Np237 in the intense (1.7 10^{14} n/s/cm^2) and 40% moderated neutron spectrum of the MEGAPIE spallation target. The online monitoring of the fission rates for those minor actinides will experimentally answer on the incineration potentials of various systems presenting similar neutron spectra (Molten salt reactors, GTMHR,...)

These challenging measurements should provide the scientific community with a set of experimental data which will allow to assess the neutronic performances of what could be the future generation of high intensity neutron sources dedicated to ADS.

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